Austin Publishing Group

“Surgical and Clinical Hypertensive Tragedies in the Frame of Poiseuille`s, Einstein`s and Kolmogorov’s Equations”

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Published Date: July 23, 2021

Abstract

Multiple tragic biophysical errors in relation to hypertension in surgery and medicine, constituting conceptual atrocities:

1. Many physicians believe that perfusion decays with the fourth power of the radius, which is the result of a doxastic misunderstanding of the Poiseuille equation. These phenomena are even more transcendent in the case of surgical situations when the homeostatic metastability is more critical and with less margin to be compensated.

2. Furthermore, when seen the occlusion of an artery, frequently, instead of measuring the radius, they measure the apparent cross- sectional area.

3. By reducing the driving pressure with antihypertensive drugs, we are decreasing axial pressure in the flow and consequently the perfusion.

4. The sphygmomanometer measures transmural pressure and not driving pressure which is what produces perfusion.

5. The main hemodynamic cause of damage is not transmural hypertension but Laplacian tension.

6. The damage to the arteries does not depend on transmural pressure but on the energy density per time, in units of Joules per cubic meter per second, or Watts per cubic meter.

7. Hypertension, *ceteris parivus*, increases perfusion.

8. The baroreceptors do not respond to transmural pressure but to Laplacian arterial tension.

9. The brain and the heart have self-regulation of their perfusion, but vasodilators increase perfusion in other tissues, reducing cerebral and coronary perfusion due to the stolen effect.

10. Strictly, all gradients constitute potential energy, as happens in the instances of the concentration gradients, temperature gradients, pressure gradients, and electrical gradients.

11. The derivative of pressure with respect to time, that is the change inpressure due to change in time, is the derivative of the work per volume per time (change in work density due to time), that is, power density.

12. What determines the perfusion is the axial gradient, not of pressurebut energy.

13. Hyperbolically if we consider taking the pressure of a pachyderm, we would obtain readings significantly higher.

14. Pressure is, in reality, energy density, which means, energy per infinitesimal unit of volume.

Citation: Lamothe N, LamotheM, Lamothe D, (2021). Surgical and Clinical Hypertensive Tragedies in the Frame of Poiseuille`s, Einstein`s and Kolmogorov’s Equation. An eBook on Cardiology and Vascular Medicine, Austin Publishing Group. Vol. 1, Chapter 1, pp. 1-21.

15. The venous return consists of the blood flow returning to the right heart. Because the input of the right side must equal its output, then in the steady-state situation, the cardiac outputs of the right and left sides are essentially equal. Consequently, the systemic venous return matches the systemic cardiac output. The venous return should be equal to or less than the cardiac output. The heart, as a pump, can not expel a volume that has not been received; not with standing, in the case of valve regurgitation, the heart can expel a fraction of the venous return twice. The clinical physician should ask himself or herself: Is the preload volume in the EDV or the pressure at the time of the EDV which has been diminished before starting the isovolumic contraction?

Prolegomena as a formal introduction

Ignorance of the disquisitions analyzed here causes at least fifteen types of atrocities in the diagnosis and management of the so-called arterial hypertension, in the clinical, but especially inthe surgical settings. Regarding the mathematical aspects, the reader can, if he is an expert, verify that they correspond to his knowledge; if not, on first reading he can conditionally accept the mathematical results and continue; so that, at another time, more calmly, he can review the mathematical foundations, which are here to give light to the concepts and not as aesthetic elements. Strictly, the appropriate approach is the application of the Popperian procedure, taking the mathematical logically apodictic results as protocol sentences or clauses [1]; considering the min a conditional logic: If the mathematical inferences are consistent, without contradictions; then, the physiological and clinical atrocities are demonstrated. The biophysical behavior of the cardiovascular system obeys the underlying biophysical laws.

Typically, the function to be optimized is to decrease the impact at a short, medium, and large term of hypertension [2]; in contrast, the function to be optimized in most surgical patients is to get adequate perfusion and oxygenation to the brain, heart, etc. during the surgery and in the perioperative time, e.g., avoiding hemodilution and low hemoglobin saturation, etc.

Besides optimizing the surgical repair, it is paramount to avoid the calamities of hypoxia and ischemia to which the surgical patient is especially prone. These surgical instances are not the appropriate moment to think in preventing hyaline arteriolosclerosis nor concentric hypertrophy ofthe left ventricle due to increased afterload pressure. Regarding arterial pressure, attention should focus on oxygen availability for the mitochondria and perfusion. The application of mathematical models according to a function to be optimized are representative of more mathematical-based approaches to complex biological problems [3-8].

The belief in an ideal eutrophic perfusion model is fallacious. Evolution is random variation and selection of genotypes through their phenotypes in terms of the reproductive success of their selfish genes, which generates extreme redundancy. The above is not an ideological position, but a phenomenological description of the evolution of the genes. In contrast to this, we can read the doxastic logic and the desiderative logic in the great texts as is the case in the following example: [9] “The morphology and local regulatory mechanisms of the microcirculation are designed to meet the particular needs of each tissue” [10]. Also, taken from the most respected text book of cardiology, “Braunwald’s Heart Disease”, in the chapter on hypertension, you can read: “the endothelial lining of blood vessels is critical to vascular health and constitutes a mayor defense against hypertension” [2,11]. This corresponds to extreme teleology!!! Byological estructures are not designed.

Derivative of pressure in time:

$$\frac{dp}{dt}=\frac{\left(\frac{N}{m^2}\right)}{\sec}=\frac{N}{m^2\sec}=\frac{N}{m^2\sec}\left(\frac{m}{m}\right)=\frac{Joul}{m^3\sec}=\frac{watt}{m^3}=\frac{power}{volume}$$

The pressure that is considered in this equation corresponds to the driving or axial pressure, which is the gradient of two different points in the vessel, therefore absolutely different from transmural pressure. It is the **power per unit area [12]** that generates instantaneous Laplacian tension; therefore, catastrophically producing hemorrhagic rupture of vessels, hyaline arteriolosclerosis, hyperplastic arteriolosclerosis, and endothelial physical damage. All these are because the system behaves catastrophically as predicted by the mathematical theory of catastrophes (Thom) as explained in this paper. This is opposed to the operational belief that it is transmural pressure, measured by a sphygmomanometer as a surrogate.

Developing insight intuition over the pragmatically meaning of energy with two scandalous beef examples:

If we could convert thoroughly 115 gr of butter into energy, and use it without any loss, we can elevate a 500 Kg cow on the tip of the Burj Khalifa, the highest building in the world with 154 floors (828 meters). Now we can use the very same cow, as an example, to show how the energy possessed by its flesh if converted thoroughly without any loss, could have solved the problem of the ship stoked in the Suez Channel. Let's believe in this example to the BBC News, April 3, 2021: The 220,000-tonne Ever Given was finally freed. Nobody has to believe it, just follow the Physical foundations and do the math. Here are the demonstrations:

$$PE = mgh$$

$$115gr\left(9\frac{c}{gr}\right)x10^{3} = 500Kg\left(9.8\frac{m}{\sec^{2}}\right)h$$

$$1,035x10^{3}c\left(4\frac{J}{c}\right) = (4,900N)h$$

$$h = \frac{4x10^{6}J}{5,000N} = 828m$$

$$E{=}200,000\ gr\left(1\frac{c}{gr}\right)x10^{3} + 70,000gr\left(9\frac{c}{gr}\right)x10^{3} = 830x10^{6}c$$

$$E = 830x10^{6}c\left(4\frac{J}{c}\right) = 3.32x10^{9}J$$

$$PE = mgh$$

$$3.32x10^{9}J = 220x10^{6}Kg\left(9.8\frac{m}{\sec^{2}}\right)h$$

$$h = \frac{3.32x10^{9}J}{2.20x10^{9}N} = 1.5m$$

This means that chemical potential energy that our hypothetical cow possess is, without losses, theoretically enough to lift the Ever Given ship to 1.5 meters above the ground without the buoyancy help of the water.

The cardiovascular system constitutes simultaneously a diversity of entities. First of all, it is a meta-topological structure that varies according to time and also depending on the organizational level, in terms of the General Systems Theory of von Bertalanffy [13].

Convective, diffusive, thermodynamic analysis should be applied to partially comprehend the nonpolynomial problem of perfusion, the subrogate of arterial pressure, and the biophysical consequences of acting accordingly in the surgical and clinical settings.

Poiseuille's and Bernoulli's equations are instances of the Navier Stokes equations and as such are considered in the present work [14].

The convective process of filtration and absorption, classically modeled according to Starling, has been improved by Pappenheimer, and now, a revised model has emerged, isolating the subglycocalyx fluid and its space [10].

On the other hand, the Fick's equation has been subsumed in the Navier Stokes equations [15].

Disquisitions and apodictic equations transformations

Convective disquisitions

The cardiovascular system has three convective loops: The transport of blood, the filtration absorption through the capillary wall, and the lymphatic circulation [7].

Convection enlarges the gradient, increasing diffusion because, thermodynamically, blood on the one hand and atmospheric air on the other, practically behave as quasi-infinite reservoirs [13].

At the capillary level, diffusion is carried out, obeying Starling's law of equilibrium, but convection is a process of fluid mechanics that obeys the Navier-Stokes equations, which we integrate with respect to distance, in all terms, so they are transformed from units of force/volume to energy/volume.

u = *velocity in x direction*

v = *velocity in y direction*

w = *velocity in z direction*

u, v, and w depend on time, x, y, and z directions

$u\ (t, x, y, z), v(t, x, y, z), w\ (t, x, y, z)$

$$\text{Acceleration in x direction} = a_x = \frac{du}{dt} = \frac{\partial u}{\partial t} + \frac{\partial u}{\partial x}\frac{dx}{dt} + \frac{\partial u}{\partial y}\frac{dy}{dt} + \frac{\partial u}{\partial z}\frac{dz}{dt} = \frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z}$$

$$\text{Acceleration in y direction} = a_y = \frac{dv}{dt} = \frac{\partial v}{\partial t} + \frac{\partial v}{\partial x}\frac{dx}{dt} + \frac{\partial v}{\partial y}\frac{dy}{dt} + \frac{\partial v}{\partial z}\frac{dz}{dt} = \frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z}$$

$$\text{Acceleration in z direction} = a_z = \frac{dw}{dt} = \frac{\partial w}{\partial t} + \frac{\partial w}{\partial x}\frac{dx}{dt} + \frac{\partial w}{\partial y}\frac{dy}{dt} + \frac{\partial w}{\partial z}\frac{dz}{dt} = \frac{\partial w}{\partial t} + u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z}$$

$$\rho\left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z}\right) = \rho g_x - \frac{\partial P}{\partial x} + \mu\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right)$$

$$\rho\left(\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z}\right) = \rho g_y - \frac{\partial P}{\partial y} + \mu\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} + \frac{\partial^2 v}{\partial z^2}\right)$$

$$\rho\left(\frac{\partial w}{\partial t} + u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z}\right) = \rho g_z - \frac{\partial P}{\partial z} + \mu\left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2} + \frac{\partial^2 w}{\partial z^2}\right)$$

$$\rho\frac{\partial v}{\partial t} = -\nabla P + \rho g + \mu\nabla^2 v$$

$$\frac{Kg}{m^3}\frac{\left(\frac{m}{seg}\right)}{\sec} = \frac{Kg}{m^3}\frac{m}{\sec^2} = \frac{N}{m^3}$$

$$\nabla P = \begin{bmatrix} \frac{\partial}{\partial x} \\ \frac{\partial}{\partial y} \\ \frac{\partial}{\partial z} \end{bmatrix} P = \begin{bmatrix} \frac{\partial P}{\partial x} \\ \frac{\partial P}{\partial y} \\ \frac{\partial P}{\partial z} \end{bmatrix} = \begin{bmatrix} \frac{\frac{N}{m^2}}{m} \\ \frac{\frac{N}{m^2}}{m} \\ \frac{\frac{N}{m^2}}{m} \end{bmatrix} = \frac{N}{m^3}$$

$$\rho g = \frac{Kg}{m^3}\frac{m}{\sec^2} = \frac{N}{m^3}$$

$$pascal\ seg\ \frac{m}{seg}=\begin{bmatrix}\frac{\partial^2}{\partial x^2}\\ \frac{\partial^2}{\partial y^2}\\ \frac{\partial^2}{\partial z^2}\end{bmatrix}v=\frac{N}{m^2}\sec\begin{bmatrix}\frac{\partial^2 v}{\partial x^2}\\ \frac{\partial^2 v}{\partial y^2}\\ \frac{\partial^2 v}{\partial z^2}\end{bmatrix}=\frac{N}{m^2}\sec\begin{bmatrix}\frac{\left(\frac{m}{\sec}\right)}{m^2}\\ \frac{\left(\frac{m}{\sec}\right)}{m^2}\\ \frac{\left(\frac{m}{\sec}\right)}{m^2}\end{bmatrix}=\frac{N}{m^2}\sec\begin{bmatrix}\frac{1}{m\sec}\\ \frac{1}{m\sec}\\ \frac{1}{m\sec}\end{bmatrix}=\frac{N}{m^3}$$

Dimensional Analysis

Let´s look each term of the first equation, since the units corresponding to each term are going tobe the same for the three equations. The first term on the left side of the equation is density $\left(\rho \text{ in units of } \frac{Kg}{m^3}\right)$ times the partial derivative of the velocity in the x direction whit respect to time $\left(\frac{\partial u}{\partial t} \text{in units of } \frac{\left(\frac{m}{\sec}\right)}{\sec}=\frac{m}{\sec^2}\right)$ which give us $\frac{N}{m^3}$, which are units of force per volume

$$\rho(\frac{\partial u}{\partial t})=\frac{Kg}{m^3}\left(\frac{\frac{m}{\sec}}{\sec}\right)=\left(\frac{Kg}{m^3}\right)\frac{m}{\sec^2}=\frac{N}{m^3}=units\ of\ \frac{F}{V}$$

Second, third and fourth terms of the left side of the equation: density $\left(\rho \text{ in units of } \frac{Kg}{m^3}\right)$ times velocity in the x direction $\left(\text{u in units of } \frac{m}{\sec}\right)$ times the partial derivative of velocity in x direction with respect to the x, y or z direction $\left(\frac{\partial u}{\partial x},\frac{\partial u}{\partial y},\frac{\partial u}{\partial z} \text{in units of } \frac{\left(\frac{m}{\sec}\right)}{m}\right)$, this is $\left(\frac{Kg}{m^3}\right)\left(\frac{m}{\sec}\right)\frac{\frac{m}{\sec}}{m}$ or $\frac{N}{m^3}$, again, units of force per volume

$$\rho\left(u\frac{\partial u}{\partial t}\right)=\left(\frac{Kg}{m^3}\right)\left(\frac{m}{\sec}\frac{\left(\frac{m}{\sec}\right)}{\sec}\right)=\left(\frac{Kg}{m^3}\right)\frac{\left(\frac{m}{\sec^2}\right)}{m}=\left(\frac{Kg}{m^3}\right)\frac{m^2}{m\ \sec}=\left(\frac{Kg}{m^3}\right)\frac{m}{\sec^2}=\frac{N}{m^3}=units\ of\ \frac{F}{V}$$

First term of the right side of the equation: density $\left(\rho \text{ in units of } \frac{Kg}{m^3}\right)$ times gravity acceleration in the x direction $\left(q_x \text{in units of } \frac{m}{\sec^2}\right)$, which are unit of $\left(\frac{Kg}{m^3}\right)\left(\frac{m}{\sec^2}\right)$ or $\frac{N}{m^3}$, once again units of force per volume.

$$\rho g_x=\left(\frac{Kg}{m^3}\right)\left(\frac{m}{\sec^2}\right)=\frac{N}{m^3}=units\ of\ \frac{F}{V}$$

Second term of the right side of the equation: the derivative of pressure with respect x in unit of

$$\frac{\frac{N}{m^2}}{m} = \frac{N}{m^3} \quad \text{or units of force per volume}$$

$$\frac{\partial P}{\partial x} = \frac{\left(\frac{N}{m^2}\right)}{m} = \frac{N}{m^3} = units\ of\ \frac{F}{V}$$

The third term of the right side of the equation has units of viscosity (μ units of $Pascal$ x sec) times the second derivative of velocity with respect to distance $\left(\frac{\partial^2 u}{\partial x^2} \text{in units of} \frac{\left(\frac{m}{\sec}\right)}{m^2}\right)$, units of $(\text{Pascal x sec})\frac{\left(\frac{m}{\sec}\right)}{m^2}$ or $\frac{N}{m^3}$, which are units of force per volume.

$$\mu\left(\frac{d^2u}{dx^2}\right) = (Pascal\ \sec)\frac{\left(\frac{m}{\sec}\right)}{m^2} = \left(\frac{N}{m^2}\sec\right)\frac{m}{m^2\sec} = \frac{N}{m^3} = units\ of\ \frac{F}{V}$$

We have seen that the units of the Navier-Stokes equation are in terms of force per cubic meter, if now we integrate both sides of each one of the three equations with respect to dx, dy or dz, respectively, the units will be force per cubic meter, times meter which is energy per cubic meter, that are units of energy density [12].

$$\int \rho\left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z}\right)dx = \int\left[\rho gx - \frac{\partial p}{\partial x} + \mu\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right)\right]dx = \frac{N}{m^2} = \frac{J}{m^3} = units\ of\ P_x\ or\ energy\ per\ cubic\ meter$$

$$\int \rho\left(\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z}\right)dy = \int\left[\rho g_y - \frac{\partial p}{\partial y} + \mu\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} + \frac{\partial^2 v}{\partial z^2}\right)\right]dy = \frac{N}{m^2} = \frac{J}{m^3} = units\ of\ P_y\ or\ energy\ per\ cubic\ meter$$

$$\int \rho\left(\frac{\partial w}{\partial t} + u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z}\right)dz = \int\left[\rho g_z - \frac{\partial p}{\partial z} + \mu\left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2} + \frac{\partial^2 w}{\partial z^2}\right)\right]dz = \frac{N}{m^2} = \frac{J}{m^3} = units\ of\ P_z\ or\ energy\ per\ cubic\ meter$$

If we do iterative integration with respect to dx, dy and dz, we get units of force per cubic meter times meter, times meter, times meter or force units:

$$\iiint \rho\left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z}\right)dx\ dy\ dz = \iiint \rho\left[g_x - \frac{\partial p}{\partial x} + \mu\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right)\right]dx\ dy\ dz = N = Units\ of\ force$$

$$\iiint \rho\left(\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z}\right)dx\ dy\ dz = \iiint \rho\left[g_y - \frac{\partial p}{\partial z} + \mu\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} + \frac{\partial^2 v}{\partial z^2}\right)\right]dx\ dy\ dz = N = Units\ of\ force$$

$$\iiint \rho\left(\frac{\partial w}{\partial t} + u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z}\right)dx\ dy\ dz = \iiint \rho\left[g_z - \frac{\partial p}{\partial z} + \mu\left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2} + \frac{\partial^2 w}{\partial z^2}\right)\right]dx\ dy\ dz = N = Units\ of\ force$$

Conservation of momentum

Now we integrate both sides of the previous equation with respect to time and we get units of force times time or impulse or momentum units [12].

$$\int \iiint \rho\left(\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}\right)dx\ dy\ dz\ dt=\int \iiint \rho g_x-\frac{\partial p}{\partial x}+\mu\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}\right)dx\ dy\ dz\ dt$$

Units:

$$N\ sec = units\ of\ impulse\ (momentum)$$

Conservation of mass

Let's divide each one of the three equations into units of force by the acceleration of gravity. The result will be in Kg or mass units.

$$\frac{\iiint \rho\left(\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}\right)dx\ dy\ dz}{g}=\frac{\iiint\left[\rho g_x-\frac{\partial p}{\partial x}+\mu\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}\right)\right]dx\ dy\ dz}{g}=\frac{N}{\left(\frac{m}{\sec^2}\right)}=Kg=units\ \text{of mass}$$

$$\frac{\iiint \rho\left(\frac{\partial v}{\partial t}+u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}+w\frac{\partial v}{\partial z}\right)dx\ dy\ dz}{g}=\frac{\iiint\left[\rho g_y-\frac{\partial p}{\partial z}+\mu\left(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}+\frac{\partial^2 v}{\partial z^2}\right)\right]dx\ dy\ dz}{g}=\ units\ of\ mass$$

$$\frac{\iiint \rho\left(\frac{\partial w}{\partial t}+u\frac{\partial w}{\partial x}+v\frac{\partial w}{\partial y}+w\frac{\partial w}{\partial z}\right)dx\ dy\ dz}{g}=\frac{\iiint\left[\rho g_z-\frac{\partial p}{\partial z}+\mu\left(\frac{\partial^2 w}{\partial x^2}+\frac{\partial^2 w}{\partial y^2}+\frac{\partial^2 w}{\partial z^2}\right)\right]dx\ dy\ dz}{g}=\ units\ of\ mass$$

Now that the three equations are in mass units and, since the masses are the same, we can equate the three equations

$$\frac{\iiint \rho\left(\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}\right)dx\ dy\ dz}{g}=\frac{\iiint \rho\left(\frac{\partial v}{\partial t}+u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}+w\frac{\partial v}{\partial z}\right)dx\ dy\ dz}{g}=\frac{\iiint \rho\left(\frac{\partial w}{\partial t}+u\frac{\partial w}{\partial x}+v\frac{\partial w}{\partial y}+w\frac{\partial w}{\partial z}\right)dx\ dy\ dz}{g}$$

$$\frac{\iiint\left[\rho g_x-\frac{\partial p}{\partial z}+\mu\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}\right)\right]dx\ dy\ dz}{g}=\frac{\iiint\left[\rho g_y-\frac{\partial p}{\partial z}+\mu\left(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}+\frac{\partial^2 v}{\partial z^2}\right)\right]dx\ dy\ dz}{g}=\frac{\iiint\left[\rho g_z-\frac{\partial p}{\partial z}+\mu\left(\frac{\partial^2 w}{\partial x^2}+\frac{\partial^2 w}{\partial y^2}+\frac{\partial^2 w}{\partial z^2}\right)\right]dx\ dy\ dz}{g}$$

The equations of Navier Stokes, knowing the initial conditions, cannot predict the condition of the system. The system can be homogeneous, but it is not so at the molecularlevel, The initial conditions need to be determined statistically, either by Lagrangian or Eulerian views, which do not give us exhaustively the conditions of every infinitesimal volume that constitute it [12].

The unmeasured components constitute points of synergetic fluctuation that generate Lorenzian chaos, and so increasing unpredictability of the system [15].

Ideally, the system should be isolated, however, there is no such instance, thus the surroundings have incommensurable effects over the system, continuously changing its condition.

The system is perturbed by its measurement, there will always be uncertainty, at least, that of Heisenberg's [12].

As an Einsteinian argument, many concepts are part of science and to try to keep them simple, is despised since they cannot be explained simpler than what is possible, such is the case of the Navier Stokes equations.

Homeostatic mechanisms have the property of hysteresis [13], evidenced by the over compensationwith which they respond to disturbance.

Blood constitutes an anisotropic medium. In terms of a vector field, in the regions of the alveoli, it acts as a source of O_2 and as a sink of CO_2, while in regions corresponding to mitochondria, blood acts as a source of carbon dioxide and as a sink for molecular oxygen. Thus, maintaining a continuous generation of a gradient for both gases that, per se, determine the flow direction in terms of Fick's law and Starling's Law. This effect is several orders of magnitude more accentuated due to the convection that is constituted by the bulk movement generated by the heart pump inside the body and the bulk movement of the gases in the respiratory tract [18].

Paradoxically, life depends on the increase of entropy consuming molecular oxygen and producing carbon dioxide in the mitochondria [18]. Also depending on the chaos produced by the action potential of the membranes, positive feedback, and in the generation of turbulence, in both fluid, gases on the one hand side and, liquid on the other, obeying the Navier-Stokes equations [13].

Isomorphically happens with nutrients, which in terms of the luminal membrane of intestinal epithelia, constitute sources towards the light of the vessels and sinks from the topological perspective of the enteral lumen. While the cellular regions of the vectorial field constitute sinks; at the same time, every one of the same cells constitutes a source of waste products. This obeys the Ficks law and convection of the blood and gastrointestinal contents producing turbulence and chaos, obeying the Navier-Stokes equations and the Lorenzian chaos [13].

Thus, life depends on the thermodynamic advantage, which creates anabolism, which in turn, makes order from chaos without violating the second law of thermodynamics. This happens since the order created is done at the expense of energy obtained from the surrounding (nutrients) and molecular oxygen creating combustion and freeing energy from the exterior sources. The addition of these effects is always an entropy; so the system diminishes its entropy at the expenses of over increasing the entropy in the surroundings. This proceeds in such a way that the overall entropy of the system plus the surrounding increase their entropy [16].

So, all the energy that we use comes from the harvesting of sunlight made by the chloroplast in the plants. The process is done cybernetically, without design, due to information. It obeys the mathematical theory of communication of Shannon, which is defined as the negative base 2 logarithm of the available states [17]. By the same token, the vector field corresponding to waste products has mainly nephrons as a sink.

Ergodic disquisitions

Ergodicity models a point in a system, which could be a dynamical system or a stochastic process, that will essentially visit all subvolumes of the space that the system moves in uniform and stochastically. Thus, the average behavior of the system can be strongly inferred from the trajectory of an indiscernible typical point. In a sufficiently large stochastic sample from a process, it corresponds to the average statistical properties of the whole process. Therefore, ergodicity corresponds to a special property of a system; it constitutes an absolute restriction statement such that is impossible for the whole system to be simplified, reduced partitioned, or factored into smaller components [15].

Diffusive disquisitions

Fick´s law of diffusion

$$J = -D\frac{d\varphi}{dx}$$

$$Diffusion\ flux = -diffusivity\left(\frac{d(concentration)}{d(position)}\right)$$

$$D = \frac{area}{time} = \frac{m^2}{\sec}$$

$$\varphi = concentration = \frac{amount\ of\ subs\tan ce}{volume} = \frac{mole}{m^3}$$

$$\frac{d\varphi}{dx}=\frac{\left(\frac{amount\ of\ \text{substance}}{volume}\right)}{\text{distance}}=\frac{amount\ of\ \text{substance}}{(\text{distance})\ (volume)}$$

$$J=\frac{m^2}{\sec}\frac{mole}{(\sec)\ (m^3)}=\frac{mole}{(\sec)\ (m^2)}=\frac{mole}{time\ (area)}$$

$$J\ in\ R^3=\text{-}D\nabla\varphi=\text{-}D\begin{bmatrix}\frac{d\varphi}{dx}\\ \frac{d\varphi}{dy}\\ \frac{d\varphi}{dz}\end{bmatrix}=\text{-}D\left(\frac{d\varphi}{dx}i+\frac{d\varphi}{dx}j+\frac{d\varphi}{dx}k\right)$$

$$\dot{V}=\frac{(P_1-P_2)AxD}{T}=\frac{\Delta PxAxD}{T}=\frac{(change\ in\ pressure)\ (Area)\ (Diffusion\ \text{constant})}{Thickness}$$

$$\frac{pressure}{Henry's\ \text{constant}}=concentration$$

$$D=\frac{\text{Solubility}}{\text{molecular weight}}=\frac{\text{Solubility}}{\sqrt{\mu\ \text{W}}}$$

Henry's law (→ Solubility)

Graham's law (→ $\sqrt{\mu\ \text{W}}$)

Logical disquisitions (doxastic and desiderative)

The decisional logic has two matrix components: the doxastic logic and the desiderative logic. Doxastic and apophantic logic. Apodictic logic constitutes a mandatory inference, in doxastic logic, once the axioms are tentatively accepted (doxastically) true [19].

Desiderative logic. The estimation of the risk constitutes a belief (doxastic logic) vs benefits (desiderative logic). This constitutes the logic of the decision. The practice of medicine should not be an instance in a Nash equilibrium, conciliating false beliefs (doxastic logic) and unreachable desires (desiderative logic) [19].

Bayesian disquisitions

Hypertension was first described as a variation of a physiological characteristic that even though it was statistically within normal distribution, increased the risk of morbidity and mortality, therefore is considered a “risk-based disease”, and the Bayesian approach may drive equivocal assumptions, especially if physiopathological components are not fully understood [19]. On the otherhand, the Bayes theorem is pervasive in all experimental science. It has been a historical tragedy in terms of criminal law, but especially in science in what we have called the bayesian tragedy [21].

Formally:

Delta (Δ) is a probability space, where we can define a sigma-algebra of events, with a probability measure. Delta would be composed of all the events of A, that is, it is a partition of the sample space that is formed by all the people with symptoms, and “De =” is an event that is intersecting the events of delta, therefore we can calculate conditional probabilities and apply Bayes' theorem [22,23].

If Δ={De: e J} is any class of mutually exclusive countable events,D_e = Disease

A = Abnormal result in the testD_j = No disease

P() = Bayesian Probability Function, If A is any abnormal test result with positive such thatthen:

$$P((D_e \mid A)) = \frac{P((A \mid D_e))\, P(D_e)}{P(A)} = \frac{P((A \mid D_e))\, P(D_e)}{\sum_{jej} P((A \mid D_j))\, P(D_j)}$$

Catastrophic and chaotic disquisitions. Thom's mathematical theory of catastrophes

Lorenz's mathematical chaos theory

The mathematical theory of catastrophes is a branch of mathematics that resulted from the discovery of abrupt changes as demonstrated by René Thom. For this reason, Thom was awarded the Fields Medal, the highest prize in the field of mathematics.

Catastrophic constitutes the paroxysmal transition from two different states of affairs, so it has a Boolean behavior, one could say Manichaean. Catastrophe occurs with the decay of metastable energy, while chaos behaves in a continuous exponential or logistic growth. The energy for chaos propagation, as in the dominos reaction, is available from the potential energy possessed by every new element captured by the chaotic phenomenon [15].

Instructive types of catastrophic phenomena are: lighting, alpha, beta, and gamma nuclear decay,phosphorescence, the release of oxygen from hemoglobin, death is a catastrophic event, the entrance to sleep, ovulation, the latch lock, the all or nothing law of synaptic transmission, the boiling of water, the explosion of soap bubbles, balloons, balls, and tires, camels' backs broken when overridden, the emission of photons and electrons, the laughter, the Kuhnian reconfiguration, sensory identification: hearing, sight, smell and taste, popcorn, breaking a potatochip in the mouth, dripping, Buridan's ass decision, the decisional process, the steps of a Turing machine, hiccups, the sneeze, the production of a thymine dimer, the bifurcation of the vessels, the equation: Y = a/(x-b), the glacier detachment, the breaking of the glass, etc [24].

In both, chaos and catastrophe, energy is the potential energy of the elements that participate in the phenomenon [24]. Chaos *Vs* Catastrophe: eureka phenomenon. Synaptic transduction is a catastrophe from a chaotic process.

The rupture of the artery in a hemorrhagic stroke is a catastrophic event.There are catastrophic events that are preceded by a chaotic process.

The yawn extends to a catastrophic event. Keyboards are catastrophic and every key is a Zeeman catastrophe Machine. The Cobordism is a catastrophe [24].

Lorenz's Chaos vs. Thom's Catastrophes. Chaos is exponential, while catastrophe is hyperbolic corresponding to y = a / (x-b) when "x" takes the value of "b" [15].

Disquisitions over turbulent flow [15]

Reynold number is dimensionless

$$\text{Re} = \frac{uL}{v}$$

$$u = \text{flow velocity in} \frac{m}{\sec}$$

$$v = \text{kenematic viscosity in} \frac{m^2}{\sec}$$

$$\text{Re} = \frac{\left(\frac{m}{\sec} m\right)}{\left(\frac{m^2}{\sec}\right)} = \frac{\left(\frac{m^2}{\sec}\right)}{\left(\frac{m^2}{\sec}\right)} = 1$$

$$\text{Re} = \frac{uL\rho}{\mu}$$

$$\frac{\left(\frac{m}{\sec}\right)(m)\left(\frac{Kg}{m^3}\right)}{Pascal\ \sec}=\frac{\left(\frac{m}{m^3}\right)\left(\frac{Kgm}{\sec}\right)\left(\frac{1}{\sec}\right)}{Pascal\ \sec\left(\frac{1}{\sec}\right)}=\frac{\left(\frac{Nm}{m^3}\right)}{Pascal}=\frac{\left(\frac{N}{m^2}\right)}{Pascal}=\frac{\left(\frac{N}{m^2}\right)}{\left(\frac{N}{m^2}\right)}=1$$

Reynold's number for capillary

$$\mathrm{Re}=\frac{ud\rho}{\mu}=\frac{u(2r)\rho}{\mu}$$

$$\frac{\left(0.03\frac{cm}{\sec}\right)2(3X10^{-6}m)\left(1,060\frac{Kg}{m^3}\right)}{(3X10^{-3}m)\,pascal\ \sec}$$

$$\frac{\left(0.03\frac{cm}{\sec}\right)\left(10\frac{mm}{cm}\right)(6X10^{-6}m)\left(1,060\frac{Kg}{m^2}\right)}{(3X10^{-3}m)\,pascal\ \sec}$$

$$\frac{(0.03)(6X10^{-5})(1,060)\frac{mmKg}{\sec m^2}}{3X10^{-3}\,pascal\ \sec}$$

$$\frac{(3X10^{-2})(6X10^{-5})(10^3)\frac{mmKg}{\sec m^2}}{3X10^{-3}\,pascal\ \sec}$$

$$\frac{(10^{-2})(6X10^{-5})(10^3)\frac{mmKg}{\sec m^2}}{10^{-3}\frac{N}{m^2}\sec}$$

$$\frac{(10^{-1})\frac{mmKg}{\sec}\frac{m}{10^3 mm}}{\frac{Kg\left(\frac{m}{\sec^2}\right)}{m^2}\sec m^2}$$

Re=10^{-4}

Turbulent flow is defined as having a Reynold number greater than 200. 10^{-4} is much less than 200, therefore there is no turbulent flow in the capillaries

Disquisitions on the kolmogorov microscales of turbulent flow

Kolmogorov`s microscales are the smallest scales in situations of turbulent flow. At the Kolmogorov`s scale, viscosity, viscosity dominates, and the turbulent kinetic energy is dissipated into heat [15].

ε (epsilon) is the average rate of dissipation, turbulence kinetic energy per unit of mass, with dimensions of energy/(time X mass), while ν (nu) corresponds to the kinematic viscosity of the fluid with dimensions of viscosity/density.

Kolmogorov conceived the concept that the smallest scales of turbulence are universal and that depend exclusively on ε (epsilon) and ν (nu), for length scales from kilometers to less than a millimeter [15].

To comprehend the derivation of Kolmogorov`s microscales, it is required their dimensional analysis and, to inspire the reader, it is done here as follows:

$$u = kenetic\ viscocity = \frac{pascal \sec}{\left(\frac{Kg}{m^3}\right)} = \frac{\left(\frac{N}{m^2}\sec\right)}{\left(\frac{Kg}{m^3}\right)} = \left(\frac{\frac{\left(Kg\frac{m}{\sec^2}\right)}{m^2}\sec}{\left(\frac{Kg}{m^3}\right)}\right) = \frac{m^2}{\sec}$$

ε = energy dissipation rate per unit mass

$$\varepsilon = \frac{\left(\frac{Energy}{time}\right)}{mass} = \left(\frac{Power}{mass}\right) = \left(\frac{Watt}{Kg}\right) = \frac{\left(\frac{Joule}{\sec}\right)}{Kg} = \frac{\left(\frac{N\ m}{Kg}\right)}{\sec} = \frac{\left(\frac{Kg\frac{m}{\sec^2}}{Kg}\right)}{\sec} = \frac{m^2}{\sec^3}$$

$$kolomogorov\ Lenght\ Scale\ = \eta\ = \left(\frac{v^3}{\varepsilon}\right)^{\frac{1}{4}} = \left(\frac{\left(\frac{m^2}{\sec}\right)^3}{\frac{m^2}{\sec^3}}\right)^{\frac{1}{4}} = \left(\frac{\frac{m^6}{\sec^3}}{\frac{m^2}{\sec^3}}\right)^{\frac{1}{4}} = (m^4)^{\frac{1}{4}} = m$$

$$kolomogorov\ Time\ Scale\ = T_\eta\ = \left(\frac{v^3}{\varepsilon}\right)^{\frac{1}{2}} = \left(\frac{\left(\frac{m^2}{\sec}\right)^3}{\frac{m^2}{\sec^3}}\right)^{\frac{1}{2}} = \left(\sec^2\right)^{\frac{1}{2}} = \sec$$

$$kolomogorov\ velocity\ Scale\ = u_\eta\ = (\varepsilon v)^{\frac{1}{4}} = \left(\left(\frac{m^2}{\sec^3}\right)\left(\frac{m^2}{\sec}\right)\right)^{\frac{1}{4}} = \left(\frac{m^4}{\sec^4}\right)^{\frac{1}{4}} = \frac{m}{\sec}$$

Disquisitions over poiseuille's law: Is decay of the flux a function of the fourth power of the radius? No, and we prove it here!!!

$$\Delta P = \dot{V}R$$

$$\Delta P = \dot{V}\frac{8nL}{\pi r^4}$$

$$\Delta P = v\pi r^2\frac{8nL}{\pi r^4}$$

$$\Delta P = \frac{8vnL}{r^2}$$

$$\dot{V} = \Delta P\frac{\pi r^4}{8nL}$$

$$\dot{V} = \frac{F}{A}\frac{\pi^2 r^4}{8\pi nL}$$

$$\dot{V} = \frac{F}{A}\frac{A^2}{8\pi nL}$$

$$\dot{V} = F\frac{A}{8\pi nL}$$

$$\dot{V} = F\frac{\pi r^2}{8\pi nL}$$

$$\dot{V} = F\frac{r^2}{8nL}$$

$$r^2 = \frac{8\dot{V}nL}{F} = \frac{8vnL}{\Delta P}$$

$$r^2 = \frac{\dot{V}}{F} = \frac{v}{\Delta P}$$

$$\frac{v}{\left(\frac{W}{V}\right)} = \frac{\left(\frac{v}{t}\right)}{\Delta P}$$

$$v = \frac{\left(\frac{v}{t}\right)\left(\frac{W}{V}\right)}{F}$$

$$v = \frac{W}{Ft}$$

$$v = \frac{Fd}{Ft}$$

$$v = \frac{d}{t}$$

$$v \equiv v$$

Disquisitions over the first law of thermodynamics. Einsteinian conservation of total energy

The true einsteinian total energy equation:

$$E = mc^2$$

$$\rho = mv$$

$$E^2 = m^2c^4 + \rho^2 v^2$$

Dimensional analysis:

$$J^2 = \left(Kg \frac{m}{\sec} \right)^2 \left(\frac{m}{\sec} \right)^2 + Kg^2 \left(\frac{m^4}{\sec^4} \right)$$

Disquisitions over mass conservation [13]. Lavoisier's conservation of the mass. Fallacy over decreased venous return. Diminished preload volume would be a violation of the mathematical theory of queues [25] and of the first law of thermodynamics too

During systole, which begins when the atrioventricular valves close, ventricular pressure increases to the point at which semilunar valves open. Continuing in systole, now being left ventricle and aorta one topological space, pressure increases until it reaches the maximum point, 120 mmHg (called the systolic blood pressure), and then begins to decrease as the left ventricleis relaxing (left ventricular pressure is less than the aortic pressure, allowing for little blood to return to the left ventricle before the aortic valve closes). Because the only terminal output from the aorta is the capillaries, blood goes from the aorta eventually to the capillaries, decreasing diastolic aortic pressure. When the ventricular pressure is above the diastolic blood pressure of the aorta, the aortic valve open again, increasing the aortic pressure now in systole, so the instant at which the aortic valve opens is when the aorta has the smallest diastolic blood pressureand it is called the diastolic blood pressure. What determines the value of the diastolic blood pressure is the ventricular contraction and how quickly blood flows from the aorta to the capillaries. The Pressure obtained with the sphygmomanometer corresponds to the maximum transmural pressure in systole and the minimum transmural pressure in diastole. If the left ventricle contracts exactly after the systole, when the left ventricle has reached a greater pressure than the aorta, the aortic valve will open and so the diastolic blood pressure will be very close to the systolic blood pressure. So, we can see that tachycardia increases diastolic blood pressure and bradycardia decreases diastolic pressure [8].

If the pumping action of the heart stops, the blood will continue moving inertially, hysteretically[24],for a few seconds, in the same direction in all the cardiovascular system, until the energy gradient disappears reaching equilibrium. thus, the axial pressure would be zero. In this point, the axial meta-topology would be the transition of the whole system in just one communicated space and, in an apparent paradox, the transmural pressure would be approximately 7 mmHg, because the cardiovascular system has been inflated to 7 mmHg since it still contains blood expanding the vessels, even though it is not being pumped by the heart. This is called the Mean Systemic Filling Pressure [8].

When the left ventricle contracts the aortic pressure increases because arteries are elastic and so there is a storage of elastic potential energy in the walls before blood flows from the aorta, andeventually to the capillaries as the arterial walls lose elastic potential energy [8].

Extending the lapidary expression by George *L. Brengelmann*: Perhaps in many situations, physicians have made correct interventions based on the idea that mean systemic pressure drivesvenous return[26]. However, reaching the right answer for the wrong reason constitutes a mixture of intuition with luck. It would be much better to move ahead empower them with knowledge and understandingof how blood volume results apportioned among vascular in the topological space of the cardiovascular system due to their energetic gradients.

Disquisitions over laplace's tension versus transmural pressure

For over 80 years, transmural pressure measurement has been the hallmark of hypertension diagnosis, although many sources of errors have been described, most of the efforts to improve this measurement have not been effective in terms of neither diagnosis, nor follow-up [27,28]. Notwithstanding, the function to optimize is perfusion through the axial gradient of energy density.

In clinical and surgical settings, transmural pressure is the gradient between an arbitrary point in the vessel (brachial artery) and the atmospheric pressure. Thus, the wall is constituted not only by the wall of the artery but also by all surrounding tissue, including muscle, aponeurosis, subcutaneous fat, and skin. The sphygmomanometer has to overcome the thick skin before having any pressure effect against the artery. The decrease in body weight and consequently thedecrease in the brachial tissue volume decreases the periarterial tissue pressure giving a false reading of hypertension.

Laplacian tension rather than transmural pressure. Capillaries *vs* vena cava [8]

If we compare two vessels, of extreme distinct radius, shows a discrepancy between wall tensionand pressure. A large vessel, like the vena cava, tolerates only 10 mm Hg of transmural pressure; however , it possesses a large mass of elastic tissue. Alternatively, a capillary, which tolerates a transmural pressure of 20 to 30 mm Hg, does not contain elastic tissue. What the vessels resist is *wall tension,* rather than transmural pressure*.* Laplace's law establishes that wall tension is the result of multiply transmural pressure by the radius. Thus, the wall tension in a capillary (10 dynes/cm) is drastically smaller than that in the vena cava (18,000 dynes/cm), even though the capillary is at a much higher pressure [29].

A phenomenological different scenery occurs at the level of capillaries in which the realm of the transversal meta-topology operates: Diffusion of liposoluble gases, diffusion of hydrosoluble substances, convection of water producing filtration and reabsorption. At this capillary level, the pressure gradient operates through the capillary wall i.e., between the intracapillary lumen and the interstitial space; even more specifically, between the side facing the luminal face of the capillary and the abluminal face of the endothelial cell which correspond to the subglycocalyx space [8]**.**

Laplacian disquisitions

It is the Laplacian tension rather than transmural pressure that should attract attention in thesurgical and clinical settings to avoid tragical atrocity.

Laplace law

$$F = k\Delta L$$

Units of k are:

$$Kg\frac{m}{\sec^2} = k\ m$$

$$k = \frac{Kg}{\sec^2}$$

Wall tension: Dividing by length

$$T = \frac{\left(\frac{Kg}{\sec^2}\right)m}{m} = \frac{\left(\frac{Kg}{\sec^2}\right)m}{m}\left(\frac{m}{m}\right) = \frac{N}{m^2}m = \frac{N}{m}$$

$$T = \Delta P\ r$$

$$T = \frac{N}{m^2}m = \frac{Work}{Area}$$

$$T = \Delta P\ r$$

$$T = \frac{F}{A}r$$

$$T = \frac{F}{\pi r^2}r$$

$$T = \frac{F}{\pi r}$$

$$T = \frac{N}{m}$$

$$T = \frac{\left(Kg\frac{m}{\sec^2}\right)}{m}$$

$$T = \frac{Kg}{\sec^2}$$

Bernoullian disquisitions

To cogitatively grasp the transcendence of the elements of the Bernoulli equation we have to appreciate them in terms of power and momentum [10]. If the fluid is static, the velocities are equal to zero:

$$P_1+\frac{1}{2}pv_1^{\ 2}+pgh_1=P_2+\frac{1}{2}pv_2^{\ 2}+pgh_2$$

$$P_1+pgh_1+P_2+pgh_2$$

$$P_1-P_2=pg(h_2-h_1)$$

Bernoulli equation in terms of Power

$$P1+\frac{1}{2}pv_1^{\ 2}+pgh_1=P2+\frac{1}{2}pv_2^{\ 2}+pgh_2$$

$$\mathrm{P}_1\dot{V}+\frac{1}{2}pv_1^{\ 2}\dot{V}+pgh_1\dot{V}=\mathrm{P}_2+\frac{1}{2}pv_2^{\ 2}\dot{V}+pgh_2\dot{V}$$

$$\frac{N}{m^2}\left(\frac{m^3}{\sec}\right)+\left(\frac{Kg}{m^3}\right)\left(\frac{m^2}{\sec^2}\right)\left(\frac{m^3}{\sec}\right)+\left(\frac{Kg}{m^3}\right)\left(\frac{m}{\sec^2}\right)m\left(\frac{m^3}{\sec}\right)$$

$$\frac{N\ m}{\sec}+\frac{Kg\ m^2}{\sec^2}\left(\frac{1}{\sec}\right)+\frac{Kg\ m^2}{\sec^2}\left(\frac{1}{\sec}\right)$$

$$\frac{J}{\sec}+\frac{J}{\sec}+\frac{J}{\sec}=Watt$$

Bernoulli equation in terms of momentum

$$\mathrm{P}_1\Delta t+\frac{1}{2}pv_1^{\ 2}\Delta t+pgh_1\Delta t=\mathrm{P}_2\Delta t+\frac{1}{2}pv_2^{\ 2}\Delta t+pgh_2\Delta t$$

$$\frac{N}{m^2}\sec+\left(\frac{Kg}{m^3}\right)\left(\frac{m^2}{\sec^2}\right)seg+\left(\frac{Kg}{m^3}\right)\left(\frac{m}{\sec^2}\right)m\sec$$

$$Kg\left(\frac{m}{\sec^2}\right)\frac{\sec}{m^2}+\left(\frac{Kg}{m^2}\right)\left(\frac{m}{\sec}\right)+\left(\frac{Kg}{m^2}\right)\left(\frac{m}{\sec}\right)$$

$$\frac{\rho}{m^2}+\frac{\rho}{m^2}+\frac{\rho}{m^2}=\frac{\rho}{A}$$

The effective determinant of the blood flow obeys the Bernoulli's equation in terms of energy, rather than pressure [13].

The hemodynamic inertia of the blood and vessels makes the pressure diminish whenever thevelocity of flow increases.

Derivative of momentum with respect to time

$$F = \frac{d(mv)}{dt}$$

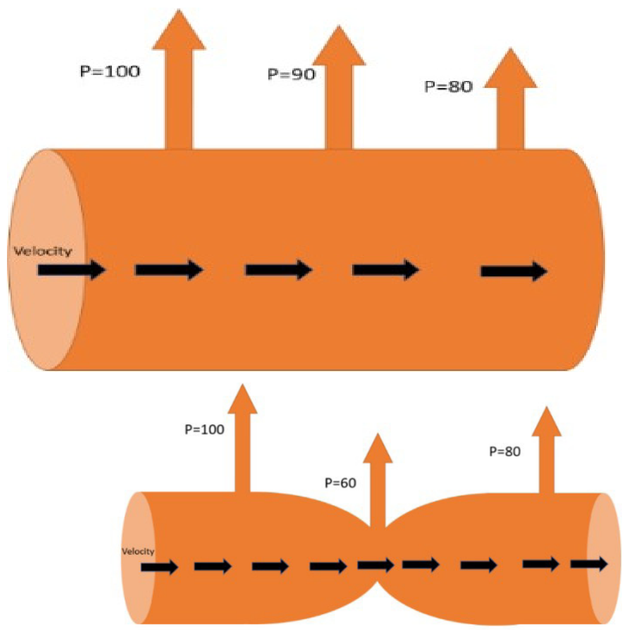
$$N = \frac{Kg\left(\frac{m}{\sec}\right)}{\sec}$$

N=N

where *F* is force and *v* is its velocity [30,31].

$$F = m\frac{dv}{dt} = ma$$

It is usual but wrongly accepted, that fluids flow from a higher to a lower pressure, which is inaccurate. Fluids flow from a higher to lower total energy. This energy is composed of pressure, which is potential energy and kinetic energy [10]. This is the basis of the Bernoulli's effect. As blood flows along a horizontal vessel with a narrow middle region, which has half the diameter of the two extremes, the pressure in the middle segment is lower than the pressure at the end of the vessel. Paradoxically, the blood flows against the pressure gradient from the lower-pressure middle segment to the higher-pressure distal segment of the vessel. Flow is the product of cross-sectional area times the velocity. Since the flow is equal in both segments of the tube, but the cross-sectional area in the middle is lower by a factor of 4, then the velocity in the middle segment has to be 4 times higher. Even though the fluid in the middle segment has a lower potential energy (pressure = 60) than the fluid at the distal extreme of the vessel (pressure = 80), it has a 16-times higher kinetic energy. Therefore, the total energy of the blood in the middle exceeds that in the distal segment, so that the blood flows down the fluid energy (potential and kinetic) gradient [8].



Cross-sectional área (A)	1	¼	1
Pressure (P)	100	60	80
Velocity (V)	2	8	2
Kinetic energy (KE)	2	32	2
Total Energy (E)	102	92	82

This is an instance of a reversible conversion between pressure, which is potential energy [10], and velocity which is kinetic energy, because velocity changes along the length of a vessel even though the blood flow is constant. These changes in velocity contribute to the changes in pressure inside the aorta.

Bernoulli's equation in terms of energy

$$P_1 + \frac{1}{2} p v_1^{\,2} + pgh_1 = P_2 + \frac{1}{2} p v_2^{\,2} + pgh_2$$

$$\frac{N}{m^2} + \left(\frac{Kg}{m^3}\right)\left(\frac{m^2}{\sec^2}\right) + \left(\frac{Kg}{m^3}\right)\left(\frac{m}{\sec^2}\right) m$$

$$\frac{N}{m^2}\left(\frac{m}{m}\right) + \left(\frac{KE}{Vol}\right) + \left(\frac{PE}{Vol}\right) = \frac{E}{Vol} = \frac{Joules}{m^3}$$

Since a low-pressure system has the potential to do work in the surrounding medium, then, it is evident that pressure is a measure of potential energy stored per volume. Pressure is therefore related to energy density and can be expressed in units such as Joules per cubic meter, which ismathematically equal to the Pascal unit.

Integration of momentum whit respect to velocity is kinetic energy

$$\rho = mv$$

$$\int \rho dv = \int mvdv = \frac{1}{2} mv^2 + C = KE$$

$$F = mg$$

$$\frac{F}{A} = \frac{mg}{A}$$

Given that.,

$$m = \rho Vol$$

then:

$$\frac{F}{A} = \frac{(\rho Vol) g}{A}$$

$$P = \rho gh$$

$$Pascal = \left(\frac{Kg}{m^3}\right)\left(\frac{m}{\sec^2}\right) m$$

$$\frac{N}{m^2} = \frac{Kg}{m \sec}$$

$$\frac{Kg\left(\frac{m}{\sec^2}\right)}{m^2} = \frac{Kg}{m \sec}$$

$$\frac{F}{A}\left(\frac{d}{d}\right) = \frac{Work}{Vol} = \frac{Joule}{m^3}$$

Eulerian *vs* lagrangian analytical approaches

The Lagrangian approach to the study of flow as if the observer travels in a particle; an allegorical analogy would be traveling passively in the fluid. Alternatively, the Eulerian approach to the study of flow consists of observing all the particles of the fluid that pass by an arbitrary fixed point in a transverse area in the trajectory of the fluid [13].

Apophantic logos as apodictic conclusions

Blood moves according to the energy gradient and not the pressure gradient increased entropy [8].It is not the perfusion but the convection in the capillary; it is the equilibrium, paradoxically it is the entropy.

Disquisitions over the vascular meta-topology. Axial meta-topology *vs.* transmural meta-topology [32]

Axial meta-topology consists of the dynamic topological transformation of the cardiovascular system between systole and diastole. In the realm of mathematics, mainly in geometric topology, Milnor´s surgery theory is a set of mathematical techniques to create one finite-dimensional manifold starting from another [32].

During systole, the cardiovascular system constitutes two communicated topological spaces: One topological continuous space consists of the left ventricle, aorta, systemic arteries, arterioles, capillaries, venules, cava veins, and right atrium. The other topological space consists of the right ventricle, pulmonary artery, pulmonary capillaries, and left atrium. During diastole the cardiovascular system constitutes two communicated topological spaces: one from the left ventricle, left atrium, pulmonary veins, pulmonary capillaries, pulmonary artery, the other consis tin the right ventricle, right atrium, cava veins, systemic capillaries, systemic arteries, and the aorta [32].

There are two ephemeral transitions (the isovolumetric relaxation and isovolumetric contraction) in which there are four topological spaces in the cardiovascular system: one space is the left ventricle, other space is the right ventricle, other space is from the left atrium, pulmonary veins, pulmonary capillaries, pulmonary artery; and, the last space consists in the right atrium, cava veins, systemic capillaries, systemic arteries, and the aorta.

In the cardiac cycle, there are fourth Thom's catastrophic transitions: 1) closure of atrioventricular valves, 2) opening of semilunar valves, 3) closure of semilunar valves and 4) opening of atrioventricular valves.

Transmural meta-topology consists of multiple topological spaces [32]

The heterogeneity of the blood converts the same cardiovascular system into different topological entities, depending on the point of analysis from the elements of blood. Thus, the cardiovascular system is a diverse meta-topological structure depending on the point of view. On a first approximation, we take the following points as frames of reference: Cellular (erythrocyte), protein molecules, monosaccharides (glucose), electrolytes, liposoluble gases, and water.

Solutes in the capillary move by transcapillary (transmural) diffusion, while the water moves by transcapillary convection (transmural).

In every mathematical transformation, we have given extreme openness to allow refutations, either formally (mathematical inconsistency) or through a crucial Popperian experiment [1]. We would stoically acknowledge it in any such instance, otherwise, we will conclude, in an Aristotelian and Laplacian isomorphism.

... Res ipsa loquitur, ergo, quod erat demonstrandum

"Tabula gratulatoria"

We are deeply grateful to the widely recognized international expert in cardiovascular electrophysiology, Dr. Luis Molina. We consider a privilege his wise criticism and deep scientific analysis, as well as his pedagogical recommendations on the content of this work.

We are also in historical debt to the distinguished researcher and international authority in computational logic and mathematical modeling, Dr. Juan Frausto, for reviewing the mathematical content and consistency of the transformations of the differential equations, that lead us, apodictically, to demonstrate the atrocities that occur when biophysics is neglected, especially the Navier Stokes equations.

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